

1 What is claimed is:

1 1. A particulate blend for use as a catalytic composition, comprising  
2 a mixture of the following components:

- 3 (i) about 15 to 35 wt. % silicon dioxide,  
4 (ii) about 1 to 6 wt. % aluminum oxide,  
5 (iii) about 5 to 20 wt. % ferric oxide,  
6 (iv) about 10 to 30 wt. % calcium oxide,  
7 (v) about 2 to 4 wt. % titanium dioxide or boron oxide,

8 and

9 (vi) about 8 to 12 wt. % transition metal salt,  
10 said wt. % being based on the total weight of components (i) – (vi), and wherein the  
11 particles of said components have a particle size of 3000 Blaine or finer.

1 2. The particulate blend of claim 1 wherein the transition metal salt  
2 is selected from the group of ferric halides, cupric halides, cobalt halides, and ferrous  
3 halides.

1 3. An aqueous catalytic composition comprising an admixture in  
2 water of the reaction products of the following components:

- 3 (i) about 15 to 35 wt. % silicon dioxide,  
4 (ii) about 1 to 6 wt. % aluminum oxide,  
5 (iii) about 5 to 20 wt. % ferric oxide,  
6 (iv) about 10 to 30 wt. % calcium oxide,  
7 (v) about 2 to 4 wt. % titanium dioxide or boron oxide,

8 and

9 (vi) about 8 to 12 wt. % transition metal salt,  
10 said wt. % being based on the total weight of components (i) - (vi), wherein the particles  
11 of said components have a particle size of 3000 Blaine or finer, and, optionally,

12 (vii) up to 50 wt. % refined hydrocarbon, based on the  
13 total weight of the admixture.

1                    4.        The catalytic composition of claim 3 wherein the transition metal  
2 salt is selected from the group of ferric halides, cupric halides, cobalt halides, and  
3 ferrous halides.

1                    5.        The catalytic composition of claim 3 wherein the refined  
2 hydrocarbon is a C<sub>5</sub> to C<sub>25</sub> saturated alkane.

1                    6.        The catalytic composition of claim 5 wherein the saturated alkane  
2 is diesel fuel or naphtha.

1                    7.        A method of making an aqueous catalytic composition which  
2 comprises:

3                    (a)        admixing the following solid particles:

4                                (i)        about 15 to 35 wt. % silicon dioxide,

5                                (ii)       about 1 to 6 wt. % aluminum oxide,

6                                (iii)      about 5 to 20 wt. % ferric oxide,

7                                (iv)      about 10 to 30 wt. % calcium oxide,

8                                (v)        about 2 to 4 wt. % titanium dioxide or boron oxide,

9 and

10                                (vi)       about 8 to 12 wt. % transition metal salt,

11 said wt. % being based on the total weight of components (i) - (vi), wherein the particles  
12 of said components have a particle size of 3000 Blaine or finer;

13                    (b)        blending said admixture from step (a) with water to form  
14 an admixture with about 2 to 10 wt. % solid components;

15                    (c)        optionally admixing up to 50 wt. % of a refined  
16 hydrocarbon, based on the total weight of the admixture, with the admixture from step  
17 (b); and

18                    (d)        blending said admixture from step (c).

1                    8.        A composition for the upgrading of a high molecular weight  
2 hydrocarbon composition to form a lower molecular weight hydrocarbon product,

3 comprising:

4 (a) an aqueous composition containing the reaction products  
5 of the following components:

- 6 (i) about 15 to 35 wt. % silicon dioxide,  
7 (ii) about 1 to 6 wt. % aluminum oxide,  
8 (iii) about 5 to 20 wt. % ferric oxide,  
9 (iv) about 10 to 30 wt. % calcium oxide,  
10 (v) about 2 to 4 wt. % titanium dioxide or boron oxide,

11 and

12 (vi) about 8 to 12 wt. % transition metal salt,  
13 said wt. % being based on the total weight of components (i) - (vi), wherein the particles  
14 of said components have a particle size of 3000 Blaine or finer, and, optionally,  
15 (vii) up to 50 wt. % refined hydrocarbon, based on the  
16 total weight of the admixture; and

17 (b) a high molecular weight hydrocarbon, the weight ratio of  
18 the high molecular weight hydrocarbon to the aqueous composition being from 2:1 to  
19 4:1.

1 9. The composition of claim 8 wherein the transition metal salt is  
2 selected from the group of ferric halides, cupric halides, cobalt halides, and ferrous  
3 halides.

1 10. The composition of claim 8 wherein the refined hydrocarbon is a  
2 C<sub>5</sub> to C<sub>25</sub> saturated alkane.

1 11. The composition of claim 10, wherein the saturated alkane is  
2 diesel fuel or naphtha.

1 12. A method of cracking a high molecular weight hydrocarbon  
2 composition to form a lower molecular weight hydrocarbon product, comprising:

3 (a) contacting an aqueous catalytic composition having a

solids content of about 2 to 10 wt. % of the total weight of the catalytic composition with a high molecular weight hydrocarbon product in a ratio of from 2:1 to 4:1, said solids comprising, based on the total wt. % of solids:

- (i) about 15 to 35 wt. % silicon dioxide,
- (ii) about 1 to 6 wt. % aluminum oxide,
- (iii) about 5 to 20 wt. % ferric oxide,
- (iv) about 10 to 30 wt. % calcium oxide,
- (v) about 2 to 4 wt. % titanium dioxide or boron oxide,

and

- (vi) about 8 to 12 wt. % transition metal salt

said catalytic composition further containing up to 50 wt. % refined hydrocarbon; and

(b) recovering the lower molecular weight hydrocarbon product formed in step (a), said lower molecular weight product having an average API value greater than the API value of the high molecular weight hydrocarbon composition.

13. The method of claim 12 wherein the transition metal salt is selected from the group of ferric halides, cupric halides, cobalt halides, and ferrous halides.

14. The method of claim 12 wherein the refined hydrocarbon is a C<sub>5</sub> to C<sub>25</sub> saturated alkane.

15. The method of claim 14 wherein the saturated alkane is diesel fuel or naphtha.

16. The method of claim 12 wherein the high molecular weight hydrocarbons are in soil containing organic impurities and said method decontaminates the soil.

17. A particulate blend for use as a catalytic composition, comprising a mixture of the following components:

3 (i) about 30 to 50 wt. % Portland cement,  
4 (ii) about 30 to 50 wt. % volcanic ash,  
5 (iii) about 2 to 4 wt. % titanium dioxide or boron oxide,  
6 and  
7 (iv) about 8 to 12 wt. % transition metal salt,  
8 said wt. % being based on the total weight of components (i) – (iv), and wherein the  
9 particles of said components have a particle size of 3000 Blaine or finer.

1 18. The particulate blend of claim 17 wherein the volcanic ash is  
2 pyroclastic rock, tuff, tuffstone, volcanic glass, pumice, scoria, mafic rock, ultramafic  
3 rock, or silicate-based zeolites.

1 19. The particulate blend of claim 17 wherein the transition metal salt  
2 is selected from the group of ferric halides, cupric halides, cobalt halides, and ferrous  
3 halides.

1 20. An aqueous catalytic composition comprising an admixture in  
2 water of the reaction products of the following components:  
3 (i) about 30 to 50 wt. % Portland cement,  
4 (ii) about 30 to 50 wt. % volcanic ash,  
5 (iii) about 2 to 4 wt. % titanium dioxide or boron oxide,  
6 and  
7 (iv) about 8 to 12 wt. % transition metal salt,  
8 said wt. % being based on the total weight of components (i) - (iv), wherein the particles  
9 of said components have a particle size of 3000 Blaine or finer, and, optionally,  
10 (v) up to 50 wt. % refined hydrocarbon, based on the  
11 total weight of the admixture.

1 21. The catalytic composition of claim 20 wherein the volcanic ash is  
2 pyroclastic rock, tuff, tuffstone, volcanic glass, pumice, scoria, mafic rock, ultramafic  
3 rock, or silicate-based zeolites.

1                    22.     The catalytic composition of claim 20 wherein the transition  
2 metal salt is selected from the group of ferric halides, cupric halides, cobalt halides,  
3 and ferrous halides.

1                    23.     The catalytic composition of claim 20 wherein the refined  
2 hydrocarbon is a C<sub>5</sub> to C<sub>25</sub> saturated alkane.

1                    24.     The catalytic composition of claim 23 wherein the saturated  
2 alkane is diesel fuel or naphtha.

1                    25.     A method of making an aqueous catalytic composition which  
2 comprises:

3                    (a)     admixing the following solid particles:

4                    (i)     about 30 to 50 wt. % Portland cement,

5                    (ii)    about 30 to 50 wt. % volcanic ash,

6                    (iii)   about 2 to 4 wt. % titanium dioxide or boron oxide,

7 and

8                    (iv)    about 8 to 12 wt. % transition metal salt,

9 said wt. % being based on the total weight of components (i) -(iv), wherein the particles  
10 of said components have a particle size of 3000 Blaine or finer;

11                    (b)     blending said admixture from step (a) with water to form  
12 an admixture with about 2 to 10 wt. % solid components;

13                    (c)     optionally admixing up to 50 wt. % of a refined  
14 hydrocarbon, based on the total weight of the admixture, with the admixture from step  
15 (b); and

16                    (d)     blending said admixture from step (c).

1                    26.     A composition for the upgrading of a high molecular weight  
2 hydrocarbon composition to form a lower molecular weight hydrocarbon product,  
3 comprising:

4                    (a)     an aqueous composition containing the reaction products

of the following components:

- (i) about 30 to 50 wt. % Portland cement,
  - (ii) about 30 to 50 wt. % volcanic ash,
  - (iii) about 2 to 4 wt. % titanium dioxide or boron oxide,
- and
- (iv) about 8 to 12 wt. % transition metal salt,
- said wt. % being based on the total weight of components (i) - (iv), wherein the particles of said components have a particle size of 3000 Blaine or finer, and, optionally,
- (v) up to 50 wt. % refined hydrocarbon, based on the total weight of the admixture; and
- (b) a high molecular weight hydrocarbon, the weight ratio of the high molecular weight hydrocarbon to the aqueous composition being from 2:1 to 4:1.

27. The composition of claim 26 wherein said high molecular weight hydrocarbon product is selected from the group of bitumens, asphaltenes, oils, and tars.

28. The composition of claim 26 wherein the volcanic ash is pyroclastic rock, tuff, tuffstone, volcanic glass, pumice, scoria, mafic rock, ultramafic rock, or silicate-based zeolites.

29. The composition of claim 26 wherein the transition metal salt is selected from the group of ferric halides, cupric halides, cobalt halides, and ferrous halides.

30. The composition of claim 26 wherein the refined hydrocarbon is a C<sub>5</sub> to C<sub>25</sub> saturated alkane.

31. The composition of claim 30 wherein the saturated alkane is diesel fuel or naphtha.

1                    32.     A method of cracking a high molecular weight hydrocarbon  
2 composition to form a lower molecular weight hydrocarbon product, comprising:  
3                    (a)     contacting an aqueous catalytic composition having a  
4 solids content of about 2 to 10 wt. % of the total weight of the catalytic composition  
5 with a high molecular weight hydrocarbon product in a ratio of from 2:1 to 4:1, said  
6 solids comprising, based on the total wt. % of solids:  
7                    (i)     about 30 to 50 wt. % Portland cement,  
8                    (ii)    about 30 to 50 wt. % volcanic ash,  
9                    (iii)   about 2 to 4 wt. % titanium dioxide or boron oxide,  
10 and  
11                    (iv)    about 8 to 12 wt. % transition metal salt,  
12 said catalytic composition further containing up to 50 wt. % refined hydrocarbon, based  
13 on the total weight of the admixture; and  
14                    (b)     recovering the lower molecular weight hydrocarbon  
15 product formed in step (a), said lower molecular weight product having an average API  
16 value greater than the API value of the high molecular weight hydrocarbon  
17 composition.

1                    33.     The method of claim 32 wherein said high molecular weight  
2 hydrocarbon product is selected from the group of bitumens, asphaltenes, oils, and tars.

1                    34.     The method of claim 32 wherein the volcanic ash is pyroclastic  
2 rock, tuff, tuffstone, volcanic glass, pumice, scoria, mafic rock, ultramafic rock, or  
3 silicate-based zeolites.

1                    35.     The method of claim 32 wherein the transition metal salt is  
2 selected from the group of ferric halides, cupric halides, cobalt halides, and ferrous  
3 halides.

1                    36.     The method of claim 32 wherein the refined hydrocarbon is a C<sub>5</sub>  
2 to C<sub>25</sub> saturated alkane.



1                    37.     The method of claim 36 wherein the saturated alkane is diesel  
2 fuel or naphtha.

1                    38.     The method of claim 32 wherein the high molecular weight  
2 hydrocarbons are in soil containing organic impurities and said method decontaminates  
3 the soil.

1                    39.     An aqueous catalytic composition comprising an admixture of a  
2 refined hydrocarbon and water containing the reaction products of the following  
3 components: silicon dioxide, aluminum oxide, ferric oxide, calcium oxide, titanium  
4 dioxide or boron oxide, and a transition metal salt, wherein the particles are finely  
5 divided.

1                    40.     The catalytic composition of claim 39 wherein the transition  
2 metal salt is selected from the group of ferric halides, cupric halides, cobalt halides,  
3 and ferrous halides.

1                    41.     The catalytic composition of claim 39 wherein the refined  
2 hydrocarbon is a C<sub>5</sub> to C<sub>25</sub> saturated alkane.

1                    42.     The catalytic composition of claim 41 wherein the saturated  
2 alkane is diesel fuel or naphtha.

1                    43.     A method of making a catalytic composition which comprises:  
2                    (a)     admixing the finely divided particles of silicon dioxide,  
3 aluminum oxide, ferric oxide, calcium oxide, titanium dioxide or boron oxide, and a  
4 transition metal salt;

5                    (b)     blending said admixture from (a) with water and a refined  
6 hydrocarbon.

1                    44.     A composition for the upgrading of a high molecular weight  
2 hydrocarbon composition to form a lower molecular weight hydrocarbon product,  
3 comprising an aqueous composition containing the reaction products of the following

finely divided components: silicon dioxide, aluminum oxide, ferric oxide, titanium dioxide or boron oxide, a transition metal salt, and, optionally, a refined hydrocarbon and a high molecular weight hydrocarbon product.

45. The composition of claim 44 wherein the transition metal salt is selected from the group of ferric halides, cupric halides, cobalt halides, and ferrous halides.

46. The composition of claim 44 wherein the refined hydrocarbon is a C<sub>5</sub> to C<sub>25</sub> saturated alkane.

47. The composition of claim 46, wherein the saturated alkane is diesel fuel or naphtha.

48. A method of cracking a high molecular weight hydrocarbon composition to form a lower molecular weight hydrocarbon product, comprising:

(a) contacting an aqueous catalytic composition containing finely divided silicon dioxide, aluminum oxide, ferric oxide, calcium oxide, titanium dioxide or boron oxide, transition metal salt, and a refined hydrocarbon with a high molecular weight hydrocarbon; and

(b) recovering the lower molecular weight hydrocarbon product formed in step (a), said lower molecular weight product having an average API value greater than the API value of the high molecular weight hydrocarbon composition.

49. The method of claim 48 wherein the transition metal salt is selected from the group of ferric halides, cupric halides, cobalt halides, and ferrous halides.

50. The method of claim 48 wherein the refined hydrocarbon is a C<sub>5</sub> to C<sub>25</sub> saturated alkane.

1                    51.     The method of claim 50 wherein the saturated alkane is diesel  
2     fuel or naphtha.